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COMPLETED

FLOOD INSURANCE STUDY

ORIGINAL

CITY OF HURRICANE, WEST VIRGINIA
PUTNAM COUNTY

MARCH 4, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 540167

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

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FLOOD INSURANCE STUDY
CITY OF HURRICANE, WEST VIRGINIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Hurricane, Putnam County, West Virginia, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by Burgess & Niple, Limited, for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-83-C-1194. This work was completed in August 1984.

1.3 Coordination

On April 15, 1983, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives of FEMA, the City of Hurricane, the West Virginia Office of Emergency Services, and Burgess & Niple, Limited (the study contractor). At this meeting, the nature and purpose of the Flood Insurance Study was explained, study streams were identified, the proposed methods of study were outlined, and the floodway concept was discussed.

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A search for basic data was made at all levels of government. In addition, notices were published in the Putnam Democrat (October 20, 1983), the Hurricane Breeze (October 20, 1983), and the Charleston Gazette (November 9, 1983) requesting that anyone having flood information make it available. No response to these notices was received.

The U. S. Geological Survey (USGS) and the Soil Conservation Service (SCS) provided information and assistance in the preparation of this report. The USGS provided maps of Putnam County and generalized equations for determining discharges in small, ungaged drainage areas in West Virginia. The SCS provided data describing the physical features and climate of the county.

On August 22, 1984, floodways and flood boundaries were reviewed with the mayor of Hurricane at an intermediate CCO meeting. The limits of the proposed boundaries were altered at this meeting to reflect recent annexations by the city.

On January 30, 1985, the results of the study were reviewed at a final CCO meeting attended by representatives of FEMA, the city, and the study contractor.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Hurricane, Putnam County, West Virginia. The area of study is shown on the Vicinity Map (Figure 1).

Hurricane Creek was studied by detailed methods for its entire length within the corporate limits. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through August 1989.

2.2 Community Description

The City of Hurricane is located in the southwestern portion of Putnam County in west-central West Virginia, approximately 11 miles southwest of the Town of Winfield, 25 miles west of the City of Charleston, and 26 miles east of the City of Huntington. Hurricane is completely surrounded by unincorporated areas of Putnam County.

Hurricane was incorporated as a town in 1888. According to the U. S. Bureau of the Census, the population of the city was 3,664 in 1980, a 5-percent increase from 1970 (Reference 1).

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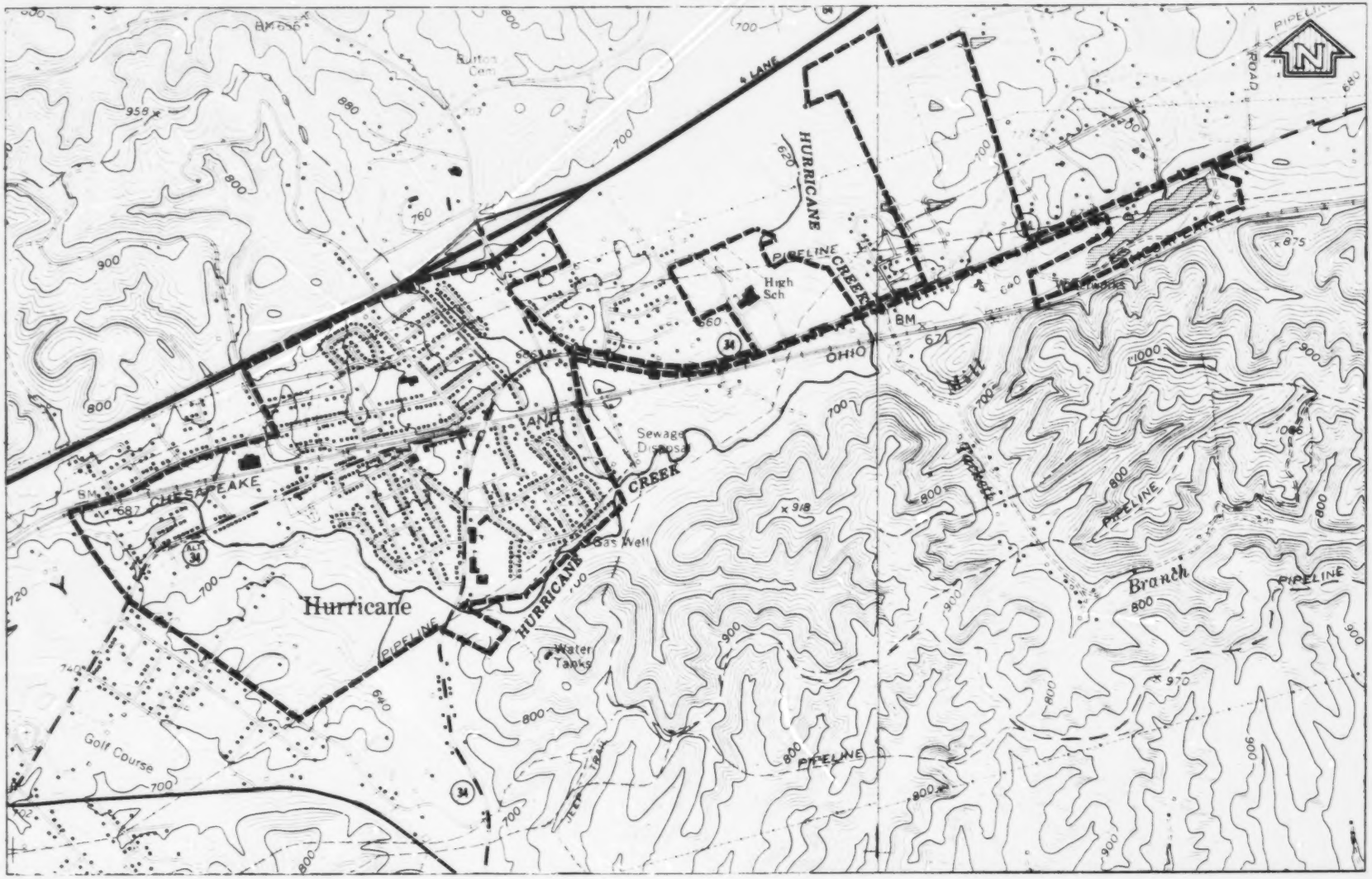

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF HURRICANE, WV
(PUTNAM CO.)

APPROXIMATE SCALE

2000 0 2000 4000 6000 FEET

VICINITY MAP

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The city is situated in the Teays Valley, a pre-glacial channel that was a previous path of the Kanawha River to the Ohio River. The land in this valley exhibits a moderate elevation (680 feet) and displays a gently rolling terrain.

The climate of the city is characterized by large annual and daily ranges of temperature. Summers are warm and humid, while winters are cold and cloudy. The average summer temperature recorded at nearby Winfield Locks and Dam has been 73 degrees Fahrenheit (°F), with winter temperatures averaging 34°F. The annual precipitation averages approximately 44 inches, with an average annual snowfall of 14 inches.

Like the remainder of Putnam County, Hurricane was once covered by a dense hardwood forest that consisted of oak, ash, walnut, and yellow poplar. Alluvial and terrace areas contain sycamore, elm, sweetgum, and other species suited to the bottomlands. Although much of this forest has been cleared, the associated tree types still constitute the major natural vegetation of Hurricane.

Most of the land in the city is used for residential and light commercial purposes. Wet lowlands remain undeveloped. Development in the area includes a major highway (State Route 34) and a railroad (Chessie System). Interstate 64 is located at the northern corporate limits of the city.

2.3 Principal Flood Problems

In the past, floods caused by the overflow of Hurricane Creek have occurred periodically in the Hurricane area. These floods have generally occurred as a result of extremely heavy rains over the upper Hurricane Creek basin, with the rains sometimes coinciding with spring thawing conditions. Although no information was available on the dates, magnitude, and specific effects of previous floods on Hurricane Creek in Hurricane, the most recent significant flood is known to have occurred in 1975. Figure 2 shows potential 100- and 500-year flood heights at one location within Hurricane.

2.4 Flood Protection Measures

The City of Hurricane has no existing local flood protection measures nor are any flood protection structures planned in the next five years.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected

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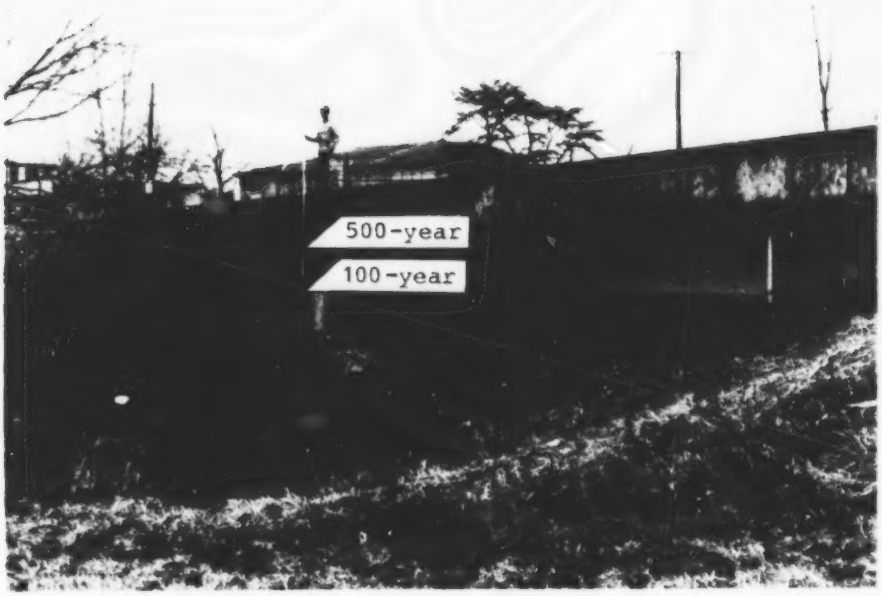

Figure 2 - Potential 100- and 500-year flood heights at the State Route 34 bridge over Hurricane Creek near the southwestern corporate limits.

to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term <u>average</u> period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding source studied in detail affecting the community.

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Since no streamflow records are available for Hurricane Creek, discharge-frequency equations developed by the USGS were used to establish the peak flows (Reference 2). These equations were developed through an analysis of gaging station records using the procedures recommended in Bulletin 17 followed by a regression analysis to establish the equations recommended for application to ungaged watersheds (Reference 3).

A summary of drainage area-peak discharge relationships for Hurricane Creek is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
HURRICANE CREEK					
At the downstream corporate limits	26.9	2,790	4,320	5,090	7,130
Above the confluence of Mill Creek	20.1	2,030	3,200	3,780	5,370
At the upstream corporate limits	17.5	1,820	2,880	3,420	4,886

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analysis of Hurricane Creek were obtained from aerial photographs taken in November 1983 (Reference 4). Below-water sections were obtained by field measurement. Bridge geometry was determined by field surveys.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 5). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for Hurricane Creek were obtained from the Flood Insurance Study for Putnam County (Reference 6).

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Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment based on aerial photographs and field observations of the channel and flood plain areas (Reference 4). The channel "n" value for Hurricane Creek was 0.045, and the overbank "n" values ranged from 0.050 to 0.100.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (Reference 7).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood

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plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway widths for Hurricane Creek extend beyond the corporate limits.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 3.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for the flooding source studied in detail in the City of Hurricane.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Hurricane Creek								
A	79,920	222/40[2]	1,815	2.8	621.0	621.0	621.8	0.8
B	81,020	128/55[2]	1,015	5.0	621.7	621.7	622.5	0.8
C	87,860	322/75[2]	1,828	2.1	627.2	627.2	628.0	0.8
D	89,500	150/130[2]	976	3.9	628.2	628.2	629.0	0.8
E	89,760	189/140[2]	1,332	2.8	630.7	630.7	631.3	0.6
F	90,530	183/110[2]	1,338	2.8	631.2	631.2	631.9	0.7
G	91,310	181/90[2]	1,131	3.3	631.8	631.8	632.6	0.8
H	91,660	171	1,314	2.9	633.3	633.3	633.8	0.5
I	92,530	281	1,856	1.8	633.6	633.6	634.4	0.8

[1]Feet above confluence with Kanawha River
[2]Width/width within corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
CITY OF HURRICANE, WV
(PUTNAM CO.)

FLOODWAY DATA

HURRICANE CREEK

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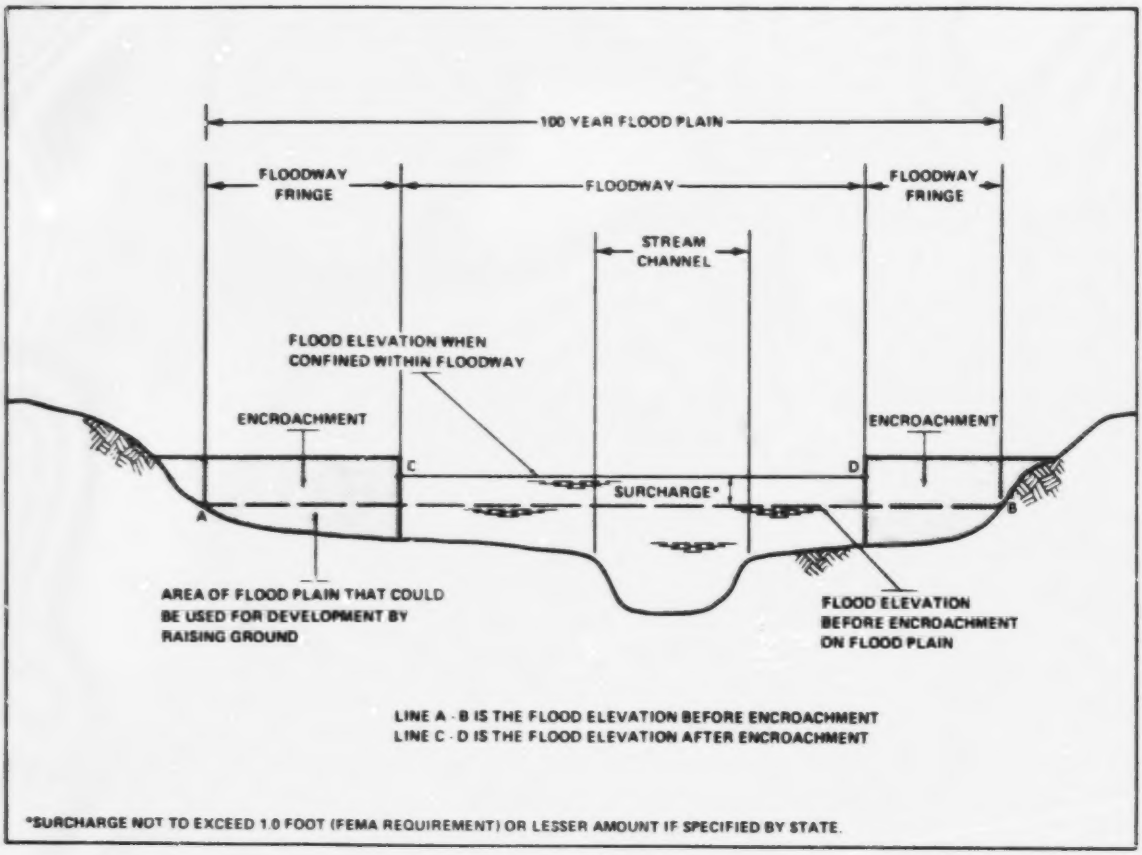
100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 3

surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The location of the reach determined for the flooding source of the City of Hurricane is shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Hurricane Creek Reach 1	01	-2.8	-0.8	+1.9	030	A6	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF HURRICANE, WV

(PUTNAM CO.)

FLOOD INSURANCE ZONE DATA

HURRICANE CREEK

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5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A6:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the community are shown in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Hurricane is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood

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elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

The Flood Insurance Study for the unincorporated areas of Putnam County is currently being prepared (Reference 6). The results of that study will be in exact agreement with the results of this study.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region III Office, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

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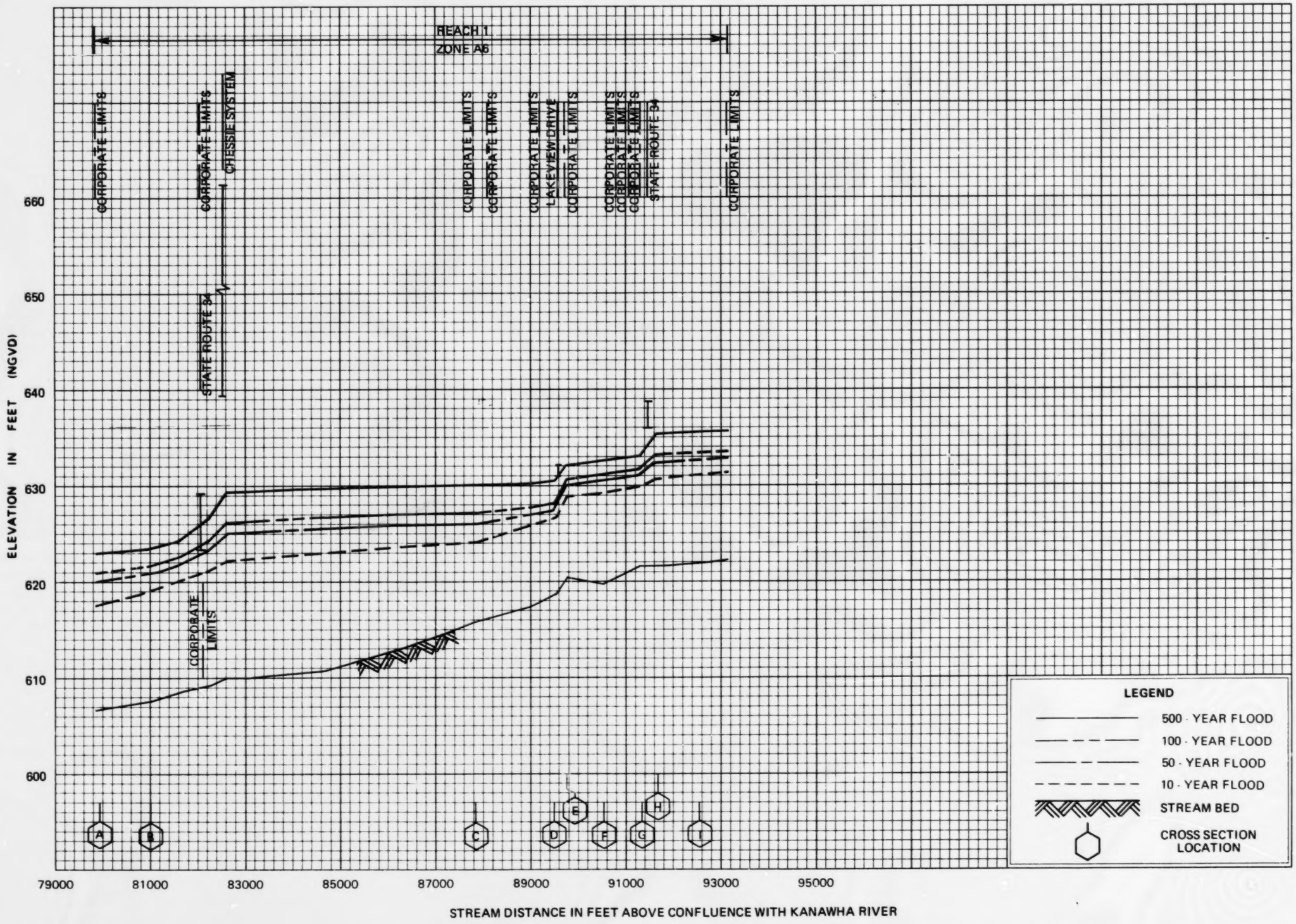

FLOOD PROFILES

HURRICANE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF HURRICANE, WV
(PUTNAM CO.)

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